13. Mesozooplankton measurements

13.1 Mesozooplankton abundance, gut fluorescence, feeding and iron content

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Mesozooplankton analysis overview and objectives

The objective of the mesozooplankton group was to study the population structure of mesozooplankton in high chlorophyll and HNLC waters, its feeding rates, herbivorous grazing rates and iron content. There were three specific aims.

1) To estimate the contribution of zooplankton to the vertical carbon flux in the study area through grazing on the phytoplankton standing stock.

2) To estimate the potential impact of *Oithona* on retarding vertical carbon flux (through feeding on faecal pellets) and its role within the microbial food web (through selective predation on microzooplankton).

3) To investigate whether mesozooplankton promote the recycling of iron in HNLC regions and iron export on the Crozet Plateau

Vertical net sampling

Mesozooplankton samples were collected at each CTD station (Table 13.1) to examine the species, stage and size structure of the zooplankton community, and to provide undamaged animals for gut fluorescence measurements, feeding experiments and iron content.

The zooplankton standing stock was sampled using a 63 μm mesh size net (single or bongo) and a single WP-2 200 μm mesh sized net towed vertically from between 200 and 100 m depth to the surface (Table 13.1). During cruise D285 the nets were deployed from the CTD winch gantry, initially off a Kevlar rope on an auxiliary gantry winch. Initial aims were to deploy nets to a depth of 200 m, but it was immediately obvious that we could not fit that much rope on to the new winch. Various trials were undertaken during the cruise to extend the sampling depth to 200 m, but after several efforts it was decided to limit the vertical extent to "semi-reliable" 100 m depth to maintain consistency during the cruise. In addition, there were spooling problems associated with the winch that caused three ropes to part during net deployments (see comments on table). The rope was finally replaced by a plastic-coated wire that, although suffering from similar jamming problems, was patched with PVC tape.

During cruise D286 the nets were deployed from a polyfil rope using an auxiliary winch mounted on the starboard deck. The rope was fed from the winch through a snatch block attached to the starboard gantry. To prevent slack in the wire a heavier weight was used attached to the net. All deployments were successful and only the one piece of rope was required.

Mesozooplankton species abundance and size fractionation

The zooplankton samples for abundance and speciation were immediately concentrated by sieving through an appropriate filter and fixed in 4 % buffered formaldehyde. Zooplankton species, stage and size structure will be examined on return to the laboratory.

Gut fluorescence

A separate WP-2 200 μm net was undertaken at each CTD station to provide live animals for gut fluorescence analysis. The net sample was diluted into a 10 l bucket with surface water from the non-toxic supply, gently mixed and aliquots of approximately 500 ml were immediately filtered on a 125 μm mesh and frozen at -20˚ C. Each sample was then defrosted in low light and four zooplankton size fractions (large (>3.5 mm), medium (2.6 – 3.5 mm), small (1.2 – 2.5 mm) and very small (<1.2 mm)) were picked and placed into 6 to 10 ml of acetone (varied during the cruise because of chemical quantity constraints) for chlorophyll extraction. Between 10 and 50 individual zooplankton were placed in each vial of acetone, depending on size class. The vials were then placed in the -20˚ C freezer, and left to extract for between 20 and 24 hours. The chlorophyll concentrations were determined fluorometrically in the same way as for filtered chlorophyll samples (see primary productivity and chlorophyll section of this cruise report). Preliminary results from D285 showed that the gut chlorophyll concentrations per animal were relatively constant for the smallest size classes (<1.2 and 1.2 – 2.5 mm), whilst the larger size classes were more variable. During D286 gut fluorescence values were far lower than D285 in all size classes except at diatom blooming station M3. In addition it was often difficult to find copepods that fitted within the large and medium size range.

Oithona similis feeding experiment

We have carried out 8 experiments (see Table 13.1) on the feeding *Oithona similis*. Zooplankton was collected using a 63 μm net and the catch diluted in a 10 l bucket with water from the non-toxic supply. Feeding rates on the different nano and microplanktonic groups were estimated by incubating 10 to 15 *O. similis* adult females, in 200 ml glass amber bottles filled with water from the Chl *a* maximum. Three replicates and three control bottles were incubated on a plankton wheel (1 rpm) for 24 h in the dark at the mixed layer temperature. An additional bottle was filled and immediately fixed to estimate the nano and microplankton concentrations at the start of the experiment. At the end of the experiment lugol's iodine was added to the bottles to obtain a final concentration of 2 % (Nielsen & Kiørboe 1994). The samples will be analysed back in the laboratory.

Iron content analysis

Water was drawn either from the iron fish (coming onto station) or from the titanium CTD at the chlorophyll maxima. Replicates of between 1 and 4 litres was filtered onto pre-weighed 0.4 and 10 μm acid-cleaned polycarbonate filters for analysis of particulate iron concentration on return to the laboratory. These filters were fast-frozen and stored in the -20˚ C freezer. These measurements will be used in concert with C:N and biogenic Si measurements taken by the primary productivity group.

At each of the "iron" stations a net sample was taken to catch live animals using, where possible due to wind constraints, a plastic net. Between 3 and 80 zooplankton (typically *Rhincalanus gigas*, *Calanus* sp., amphipods and euphausiids) were incubated in 0.4 μm filtered seawater for 6-12 hours. These zooplankton were fast-frozen and stored in the -20˚ C freezer for analysis of iron and carbon content on return to the laboratory. The incubation water was then filtered onto a pre-weighed acid-cleaned 2 μm filter to collect any faecal material (and the filter frozen). However, only once did there appear to be faecal material retained on the filter. All volume filtered and zooplankton picked are given in the Table 13.2.

Table 13.1 Mesozooplankton stations

Station	Depth (m)	Abundance		Gut fluor	Feeding	Iron	Comments
		63 μm	200 μm				
D285							
15498	150	√	√				
15490	150	√*	√				*Kevlar rope parted
15493	100	√	√	√			
15494	100	√	√	√			
15495	100				√	√*	*plastic net
15498	100	√*	√	√			*To 200 m depth, rope parted
15499	100					√*	*plastic net
15500	100	√	√*				*To 200 m depth, rope parted
15502	100	√	√	√			
15506	100	√	√	√*			*wrong mesh used
15507	100	√	√	√			
15511	100				√	√*	*plastic net
15513	100	√	√	√			
15516	100	√	√	√			Very windy
15518	100				√	√*	*metal net due to wind
15520	100	√	√	√			
15525	100	√	√	√*			*aborted due to cable split
15526	80			√	√	√*	*metal net due to wind
15527	100	√	√	√			
15528	100	√	√	√			
15532	100	√	√	√			
15534	100					√*	*metal net due to wind
15538	100	√	√	√		√*	*metal net due to wind
15542	100					√*	*metal net due to wind
15543	100	√	√	√			
15545	100	√	√	√			
15546	100	√	√	√			
15547	100	√	√	√			
15548	100	√	√	√			
D286							
15552	100	√	√	√			New winch system
15554	100					√	Metal net due to winch
15556	100	√	√	√			

15557	100	√	√	√			
15562	100					√	Metal net due to winch
15563	100	√	√	√			
15565	100						Abandoned due to wind
15567	100	√	√	√			Very windy
15568	100		√	√			Baie Americane
15570	100	√	√	√			
15574	100	√	√	√		√	Metal net due to winch
15579	100		√	√√√			4 gut fluor samples
15580	100		√	√			
15581	100		√	√			
15582	100	√	√√	√√		√	#2#3 delayed freezing for 4 hours. Metal net due to winch
15584	100	√	√	√			
15585	100	√	√	√			
15586	100	√	√	√			
15589	100	√	√	√			
15596	100	√	√	√			
15598	100		√√	√√			
15599	100					√	Metal net due to winch
15605	100	√	√	√		√	Metal net due to winch
15609	100		√	√			
15610	100		√	√			
15613	100	√	√	√		√	Metal net due to winch
15621	100	√	√	√		√	Metal net due to winch
15623	100	√	√	√			
15629	100	√	√	√		√	Metal net due to winch
15632	100						Net for additional samples

Table 13.2 Mesozooplankton sampling for iron content

Station	Uway/D	10 µm filters	0.4 µm filters	Zooplankton picke	Fecal material	Comments
D285						
15491	Uway	2 l C50 20.27 2 l C43 20.89	1 l A92 16.13 1 l A80 15.80	Nets aborted	X	Polysulphone rig
15495	Uway	4 l C36 20.34 4 l C42 15.65	2.5 l A94 16.27 2.5 l A91 15.94 2.5 l A95 15.65	B44 33.47 B46 33.43 B50 33.10 B15 32.73 3 x 10 R.g*	X	Teflon rig Polysulphone used
15499	40 m	3 l C25 20.44 3 l C30 20.37	3 l A79 15.73 3 l A88 15.83	2 x 8 R.g 1 x 7 R.g 1 x 9 R.g 1 euphausiid	X	Teflon rig Polysulphone used
15511	Uway	4 l C31 20.53 2 l C41 20.74	4 l A78 15.67 2 l A73 16.10	18 R.g 20 R.g 15 R.g 6 R.g 2 amphipods	X	Si/C/N taken 1.5 l in 10 µm 2 x 1 l in 0.4 µm 2 x 1 l GF/F 1 l <10µm GF/F
15518	80 m	4 l C24 20.66 4 l C29 20.49	3 l A77 16.36 3 l A61 16.09	22 R.g 27 R.g 2 euphausiid	B91 32.2 From 33 R.g	Potential contamination fron polysulphone rig identified
15526	35 m	2.5 l C28 20.29 2.5 l C44 20.42	1.5 l A65 15.86 1.5 l A87 15.73 1 l A62 16.19	22 R.g 5 R.g	B94 33.1	Fibres removed fro 2 µm filter
15534	25 m	4 l C49 19.40 3 l C20 21.03*	2 l A52 15.88 2 l A63 15.87	8 R.g		* prob. filtering not many R.g
15538	35 m	2 l C26 20.56 2 l C38 20.48	1.5 l A82 16.07 1.5 l A74 16.49	2 euphausiid 2 amphipod 10 R.g, 18 R.g, 6 R 17 R.g	B97 33.0	17 copepods incubated (no fecal material)
15542	55 m	2 l C16 20.87 2 l C17 19.60	0.5 l A81 15.66 0.5 l A84 16.12*	3 R.g 7 Cal	X	* dropped pot. contamination

			0.5 l A76 15.80			
D286						
15552	15 m	3 l C21 20.07 3 l C45 20.25	2 l A51 15.54 2 l A96 15.94	2 x 3 x 15 CV Cal	X	
15561	35 m	3 l C48 20.55 3 l C33 20.43	2 l A72 16.16 2 l A98 16.33	2 x 5 amphipods 2 x 15 Cal	18 Cal B42 33.0 11 Cal B48 32.5	
15572	25 m	3 l C22 19.82 3 l C6 20.16	2 l A90 16.12 2 l A81 16.37	3 x Cal, 5 R.g (Fe) 3 x Cal, 5 R.g (C:N)	X	
15581	40 m	2 l C34 20.71 2 l C37 20.38	2 l A99 16.26 2 l A85 15.81	3 x 10 Cal (Fe) 3 x 5 Cal (C:N)	X	
15592	25 m	3.5 l C8 20.11 3.5 l C11 20.50	2 l A69 15.58 2.5 l A68 16.25	3 x 10 Cal, 10 R.g (3 x 5 Cal, 8 R.g (C:	X	
15598	40 m	3 l C19 20.34 3 l C12 20.04	2.5 l A56 15.40 2.5 l A55 15.73	3 x 10 Cal, 3 x 10 R (Fe) 3 x 5 Cal, 5 x 5 R.g (C:N)	X	
15602	40 m	3 l C1 20.67 3 l C2 18.89	2.5 l A70 16.01 2.5 l A54 15.72	2 x 10 + 8 Cal, 3 x R.g (Fe) 3`x 5 Cal, 3 x 5 R.g (C:N)	X	
15613	20 m	1 l C9 20.89 1 l C5 19.97 1 l C4 20.44	1.5 l A59 16.318 1.5 l A60 15.85	3 x 10 Cal, 3 x 10 R (Fe) 3 x 5 Cal. 3 x 5 R.g (C:N)	X	Smoke (from AC unit) contanimatio possible
15621	12 m	1 l C10 20.33 1 l C40 20.85	1.5 l A64 15.46 1 l A57 15.45	3 x 10 Cal, 3 x 10 R (Fe) 3 x 5 Cal, 3 x 5 R.g (C:N)	X	
15629	20 m	1.5 l C35 20.46 1.5 l C13 20.84	1.5 l A49 15.66 1.5 l A53 15.59	3 x 10 Cal, 3 x 10 R (Fe) 3 x 5 Cal, 3 x 5 R.g (C:N)	X	

*R.g = *Rhincalanus gigas*

*Cal = *Calanus* species